National Aeronautics and Space Administration

C3P Center for Pollution Prevention Program

esa ESTEC

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"Global Collaboration in Sustainable Environmental and Alternative Energy Strategies"

Microgeneration, sustainable implementation and utilization

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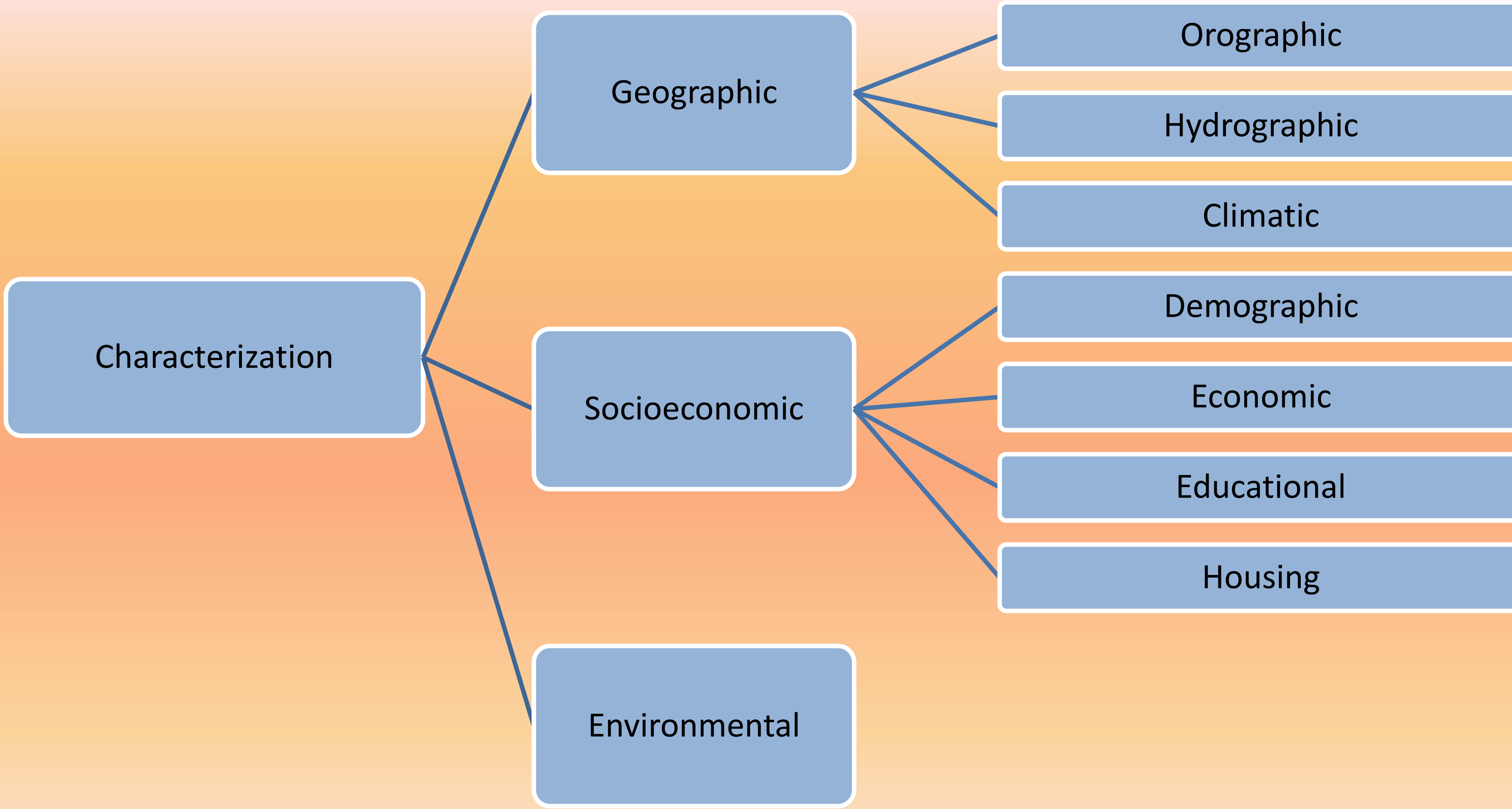
Overview

- Objectives
- Regional characterization
- Microgeneration technologies
- Regional analysis
- Scenarios
- Conclusions
- Future developments

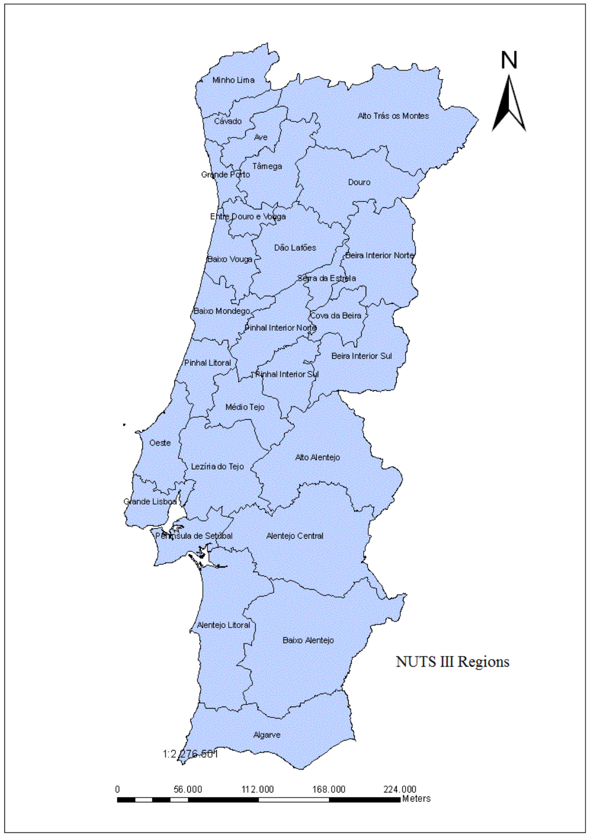
Objectives

- Evaluate the present microgeneration situation in Portugal;
- Define the most suitable technology to the individual regions according to the characterization of both energetic potentials and possible micro producers;
- Propose changes to the current situation in order to increase the sustainability of microgeneration, combining the Rational Use of Energy (RUE) and Buildings Energy Efficiency (BEE) with small scale renewable energy technologies.

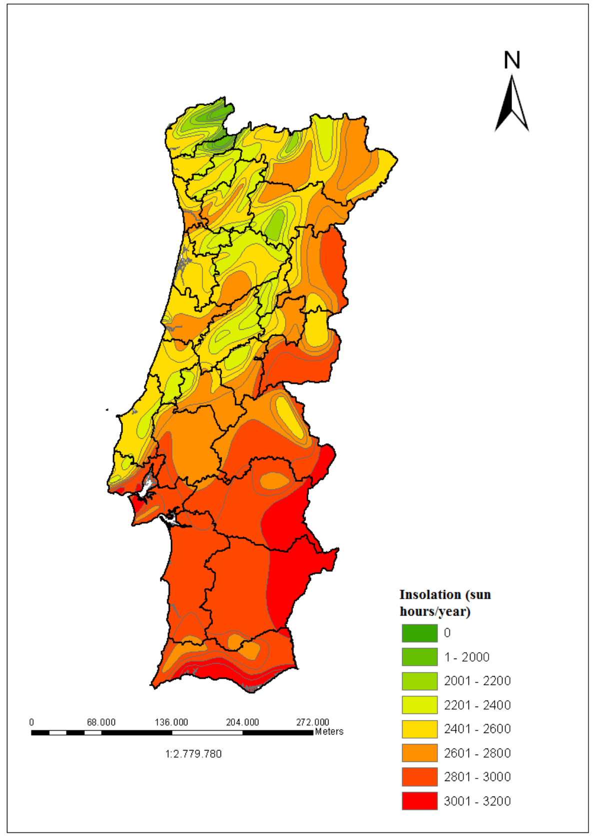
Regional characterization (I)



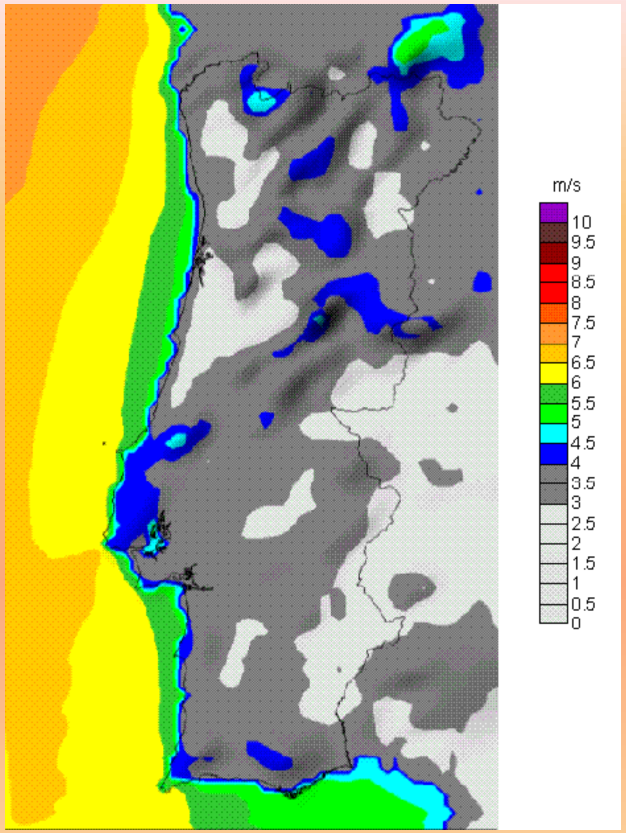
Regional characterization (II)



NUTS III regions

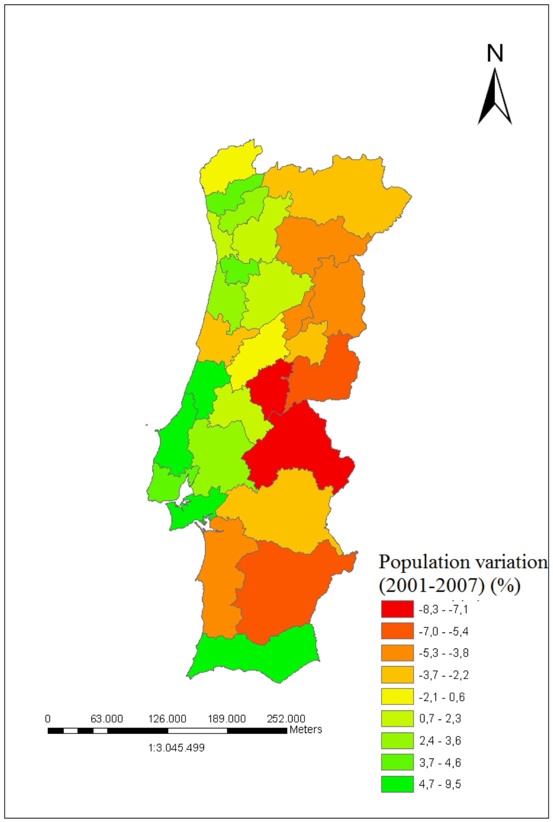


Insolation

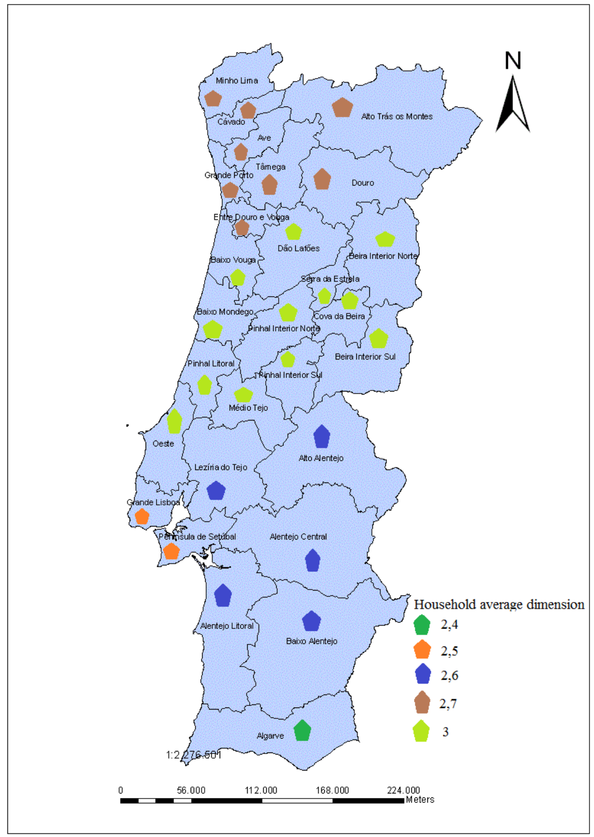


Wind speed

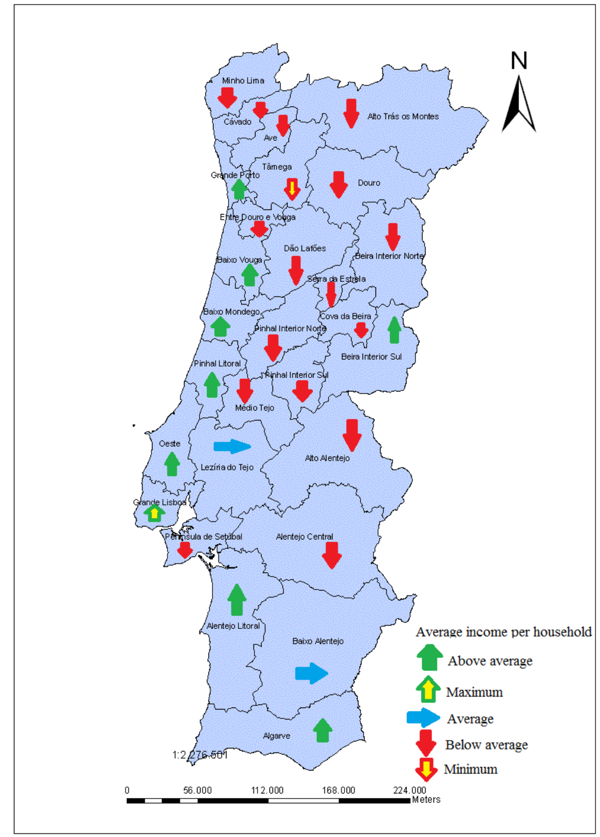
Regional characterization (III)



Population variation between 2001 and 2007



Household average dimension

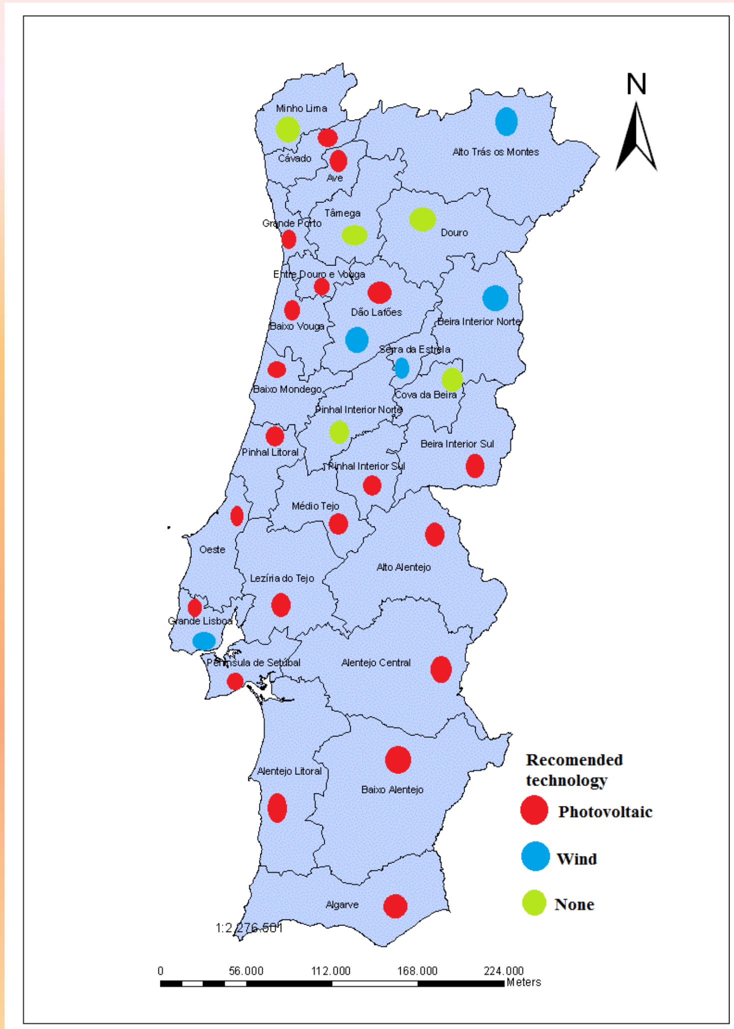


Household average income

Microgeneration technologies

- **Electricity production**
  - Photovoltaic systems
    - 3,8 kW
    - 3,78 kW
    - 4,05 kW
  - Wind systems
    - 3,20 kW
    - 6 kW
- **Heat/Hot Water production**
  - Solar thermal (300 L tank capacity)
    - Flat plate collector (4 m^2)
    - Evacuated tubes (44 tubes)
  - Biomass
    - Firewood boiler (24 kW)
    - Wood pellets salamander stove(13, 5 kW)
    - Wood pellets boiler (14 kW)

Regional analysis



Recomended technologies

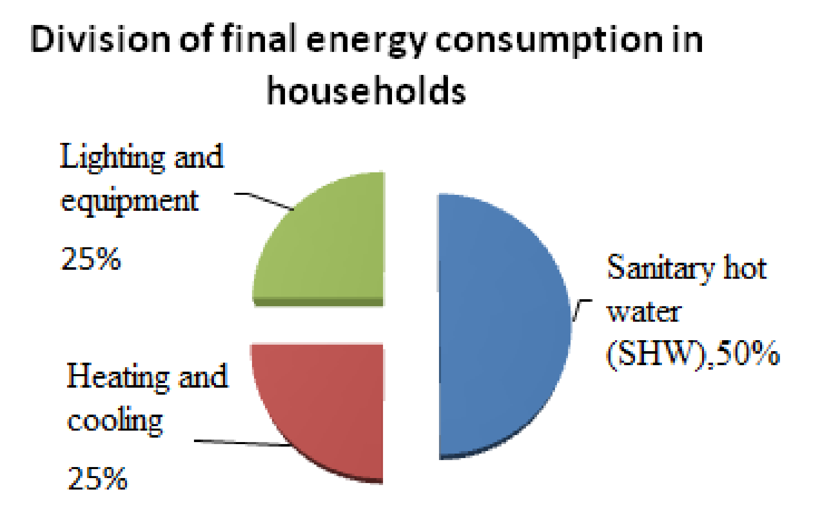
Photovoltaic → PBT= 16 years; EPBT= 11,5 years → Avoided Emissions =56%

Wind Power → PBT= 13,6 years; EPBT= 6 years → Avoided emissions= 57%

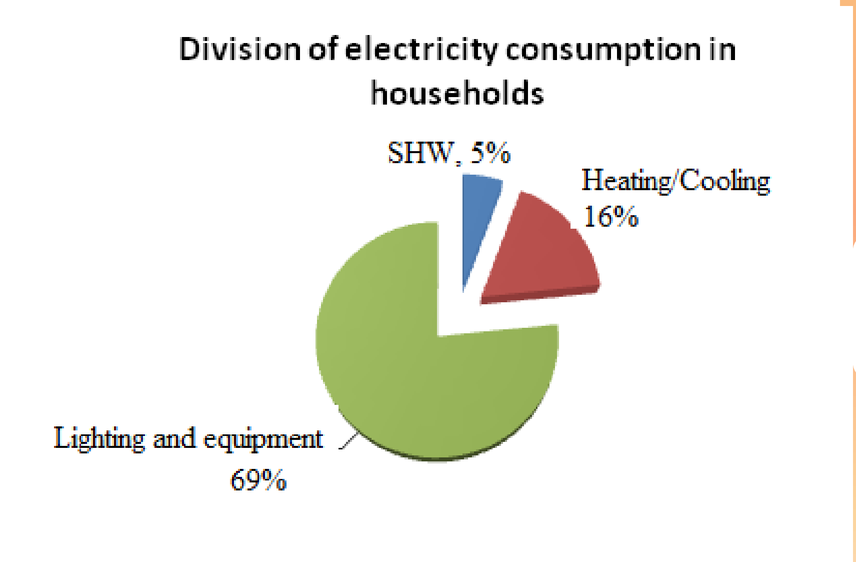
Solar Thermal → PBT= 15,7 years; EPBT= 1 year → Avoided Emissions= 60%

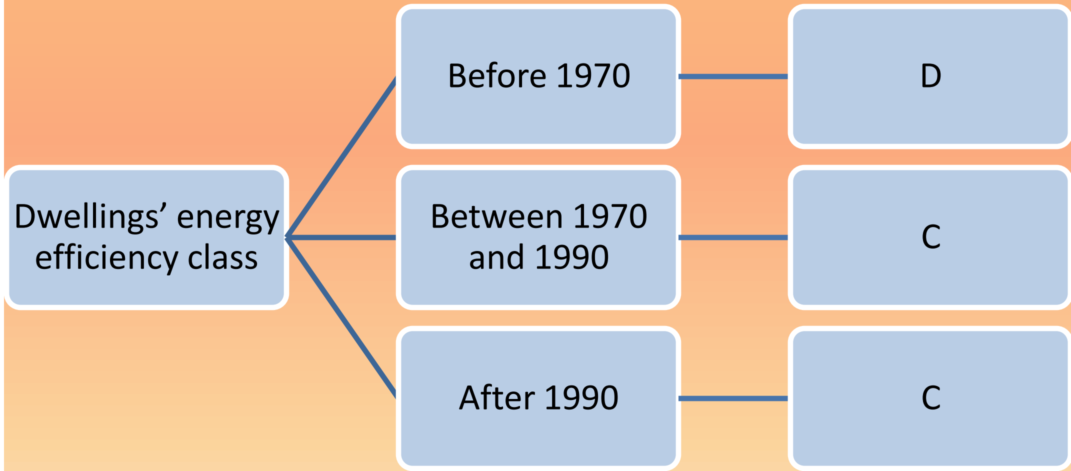
Biomass → EPBT=1,1 year → Avoided emissions= 70%

Scenario I

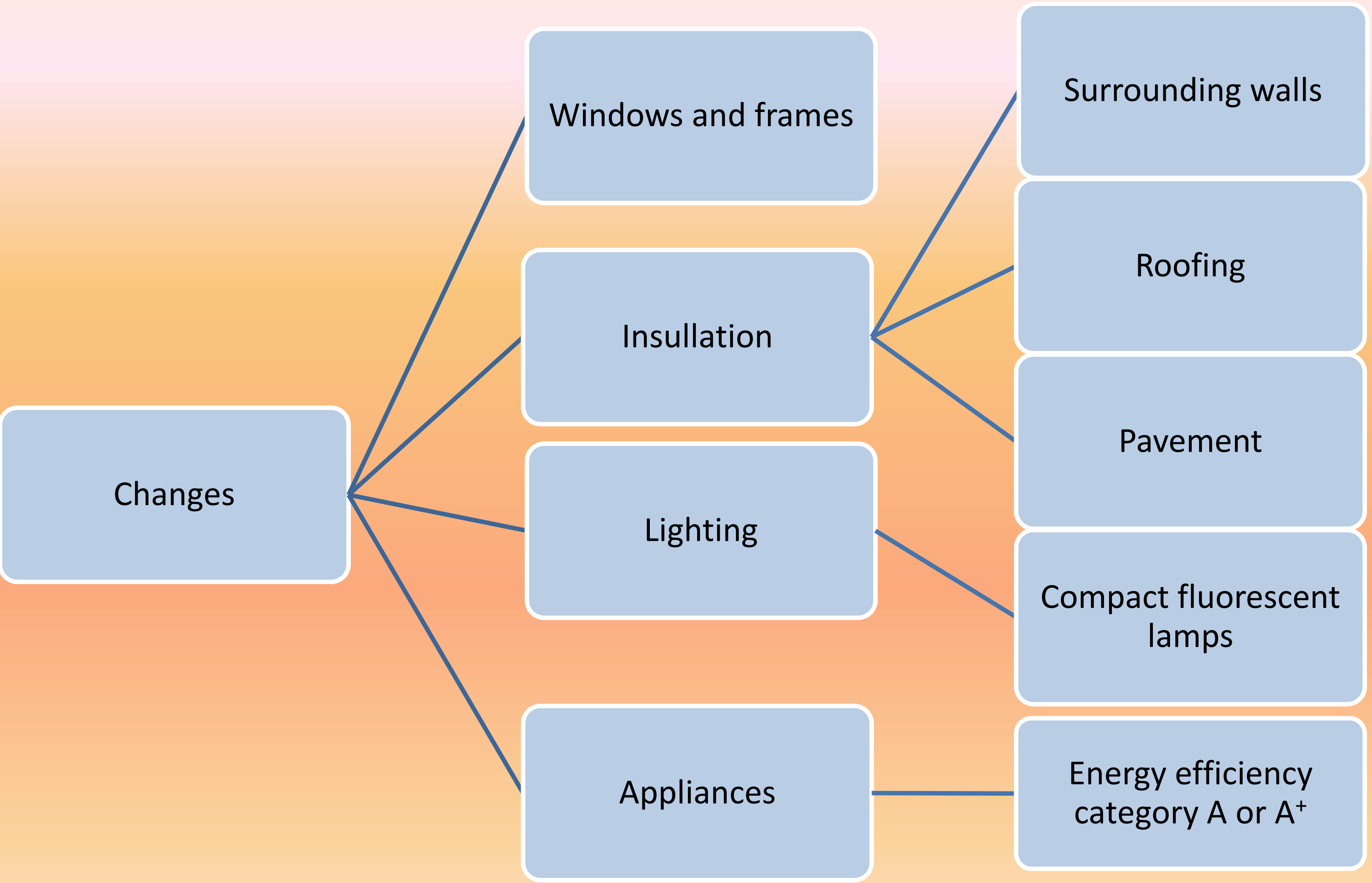

Division of final energy consumption in households
Lighting and equipment
25%
Sanitary hot water (SHW),50%
Heating and cooling
25%


CLASSE ENERGÉTICA
A
A+
B-
B
C
D
E
F
G
Certificação Energética e Ar Interior
EDIFÍCIOS

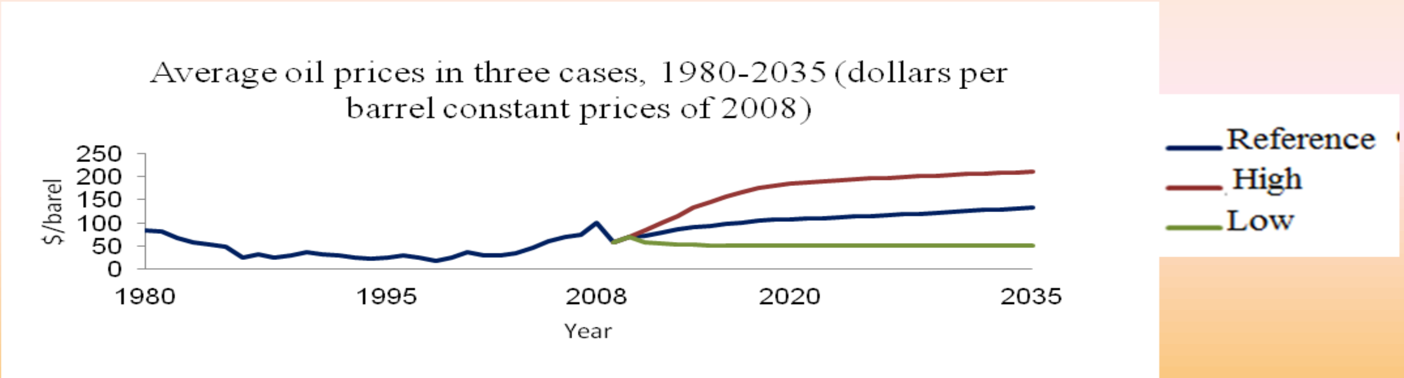

Division of electricity consumption in households
SHW, 5%
Heating/Cooling
16%
Lighting and equipment
69%

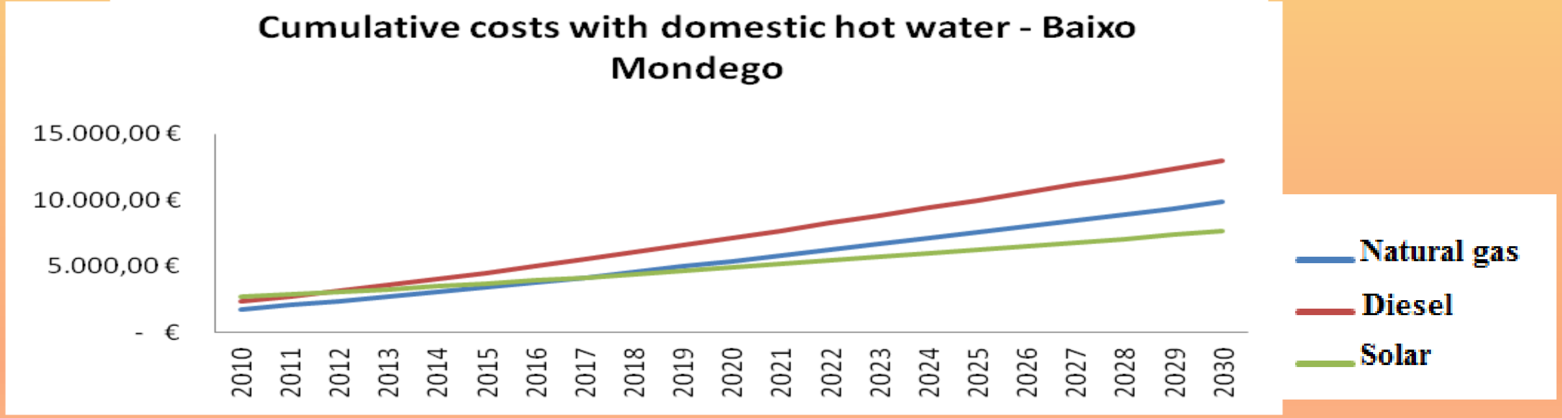

Dwellings' energy efficiency class
Before 1970
D
Between 1970 and 1990
C
After 1990
C

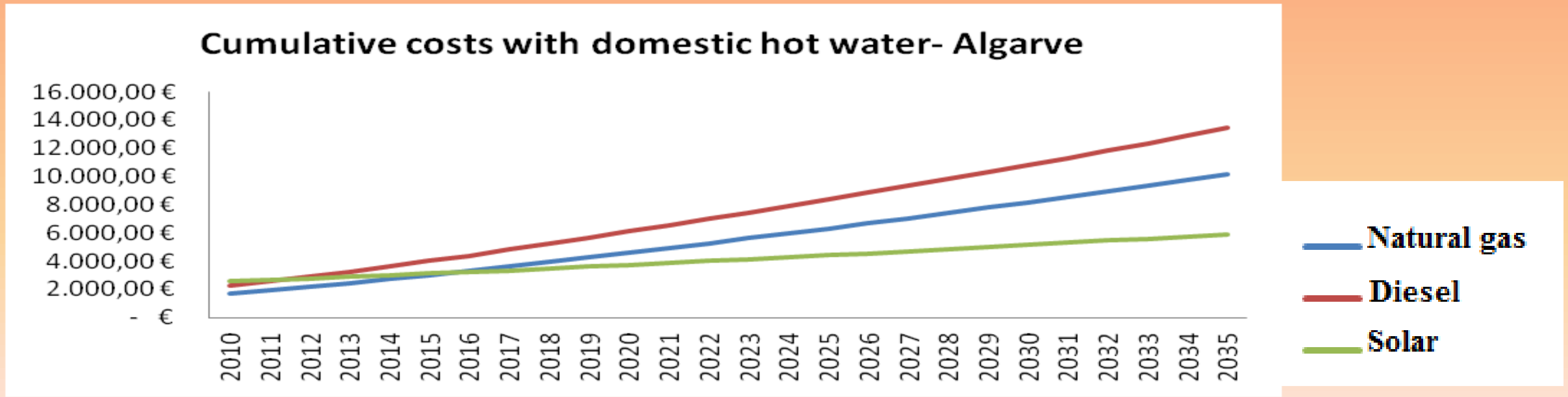
Scenario II


Changes
Windows and frames
Insullation
Lighting
Appliances
Surrounding walls
Roofing
Pavement
Compact fluorescent lamps
Energy efficiency category A or A+

Scenario III







Conclusions

- The implementation difficulties are mainly due to lack of economic viability and especially in poorer regions.
- The sun is the most stable resource and has the more predictable production.
- The photovoltaic solar energy proves to be energetically intensive and costly with high PBT and EPBT.
- The wind is a highly variable resource, needing in-depth studies for each specific location.
- The wind technology is less expensive but produces much less energy.

Conclusions

- The solar thermal technology will be a priority due to its economic viability and to the current consumption of DHW, which represents 50% of energy consumption in the domestic sector.
- Insulation the buildings reduces, to about half, the nominal energy needs for air conditioning but has high PBT.
- The biomass combustion equipments have higher acquisition costs than those for fossil fuels, but they are more economical over their lifetime.
- The choice of biomass equipment falls on those who use wood pellets, due to its high economic and environmental efficiency.
- Considering the evolution of oil prices expected over the next 20 years concluded that the focus on solar thermal technology is clearly the best choice for Portugal.

Future developments

- Determine the impact of the measures proposed in the indicators of sustainable development.

- Development of more localized studies applying them to a general access to software that can evaluate which could the best solution for each household.

- Studying in detail the social and economic implications of domestic production of equipment on national and regional economic development.

- Extend the scope of this type of analysis, devising a model for analyzing the sustainability of energy production projects of various sizes, with different locations and sources of energy.